

**DRAWING AMENDMENTS (Other than Those Requested on Form PTO-948)**

Drawing amendments are provided on a separate sheet accompanying this Response.

**REMARKS**

**1. The Amendments and the Support Therefor**

Five claims (3, 10, 14, 20, 24) have been canceled, no new claims have been added, and claim 15 has been amended to leave claims 1-2, 4-9, 11-13, 15-19, and 21-23 in the application.

No new matter has been added by the amendments, wherein independent claim 15 has been amended to recite the timing of the second valve opening (this matter finding support in claim 1 and throughout the specification).

**2. Section 1 of the Office Action: Drawings**

A new drawing sheet (labeled “Replacement Sheet” in the top margin) accompanies this Response, wherein a new **FIG. 2** illustrates the matter requested at Section 1 of the Office Action.

**3. Sections 2-3 of the Office Action: Double Patenting**

The nonstatutory double patenting rejection is obviated by the accompanying terminal disclaimer filed in compliance with 37 CFR §1.321.

**4. Section 4-5 of the Office Action: Rejection of Claims 10, 14 and 24 under 35 USC §112(2)**

These rejections are obviated by the cancellation of these claims.

**5. Sections 6-7 of the Office Action: Rejection of Claims 1-24 under 35 USC §102 in view of EP 1136682 to Osigo et al.**

Kindly reconsider and withdraw these rejections. FIG. 15(c) of *Osigo* is cited as showing the *exhaust* valves opening twice at the same times as those claimed, but the claims are directed to opening of the *intake* valves. A review of FIG. 15(a) of *Osigo* clearly illustrates that *Osigo*’s intake valves are

opened at different times than those claimed.

**6. Section 8 of the Office Action: Rejection of Claims 1-24 under 35 USC §102 in view of EP 0473258 to Wakeman**

Kindly reconsider and withdraw these rejections. EP 0473258 to *Wakeman*, which is directed to reduction of pumping work at part load conditions, describes the following:

*In FIG. 1:*

- At the end of the exhaust stroke, which is shown by the PV (pressure-volume) trace leading downwardly from top right, then leftwardly toward A at 1 bar pressure, the exhaust valve closes at top dead center A (see column 3 line 49-column 4 line 10);
- The intake stroke then begins (the PV trace leading downwardly from A, then rightwardly), with the intake valve open (column 4 lines 9-15);
- At bottom dead center B, the intake valve closes and compression begins, with the compression PV trace sweeping leftwardly and upwardly (column 4 lines 15-18).

Thus, note that the intake valve is only opened once, and during the intake stroke.

*In FIG. 2:*

- At the end of the exhaust stroke, which is shown by the PV (pressure-volume) trace leading downwardly from top right, then leftwardly toward A at 1 bar pressure, the exhaust valve closes at top dead center A (column 4 lines 19-24);
- The intake stroke then begins (the PV trace leading downwardly and rightwardly from A), with the intake valve closed (column 4 lines 22-27);
- At bottom dead center B, compression begins with the intake valve open, causing rapid blowdown during the upwardly moving trace C, and then the intake valve then closes to have the compression stroke continue along the leftwardly and upwardly moving PV trace (column 4 lines 24-40).

Thus, note that the intake valve is only opened once, and during the compression stroke.

*In FIG. 3:*

- At the end of the exhaust stroke, which is shown by the PV (pressure-volume) trace leading downwardly from top right, then leftwardly toward A at 1 bar pressure, the exhaust valve closes at top dead center A (column 4 lines 50-51);
- The intake stroke then begins with the intake valve open, with the PV trace traveling rightwardly at a pressure near 1 bar, and with the intake valve then closing at E. The PV trace then continues to bottom dead center at B (column 4 lines 51-54).
- At bottom dead center B, compression begins with the intake valve open, causing rapid blowdown during the upwardly moving trace F. The intake valve then closes to have the compression stroke continue along the leftwardly and upwardly moving PV trace (column 4 line 57-column 5 line 8).

*In FIG. 4:*

- At the end of the exhaust stroke, shown by the PV (pressure-volume) trace leading downwardly from top right, then leftwardly toward A at 1 bar pressure, the exhaust valve closes at top dead center A (column 5 lines 9-21);
- The intake stroke then begins with the intake valve open, with the PV trace traveling rightwardly at a pressure near 1 bar, and with the intake valve then closing at E. The PV trace then continues to bottom dead center at B (column 5 lines 9-21).
- At bottom dead center B, compression begins with the intake valve closed until G. At G, the intake valve opens, causing blowdown to 1 bar. The intake valve then closes to have the compression stroke continue along the leftwardly and upwardly moving PV trace (column 5 lines 9-21).

Note that the strokes traverse approximately 350 cc of cylinder volume, as can be seen by subtracting the volume at top dead center A from the volume at bottom dead center B. Looking to FIGS. 3 and 4, which illustrate the only valve actuation schemes wherein the intake valves are opened twice:

- In FIG. 3, the intake valve is open from A (top dead center) to E at the start of the intake stroke, and then over trace F at the start of the compression stroke starting at bottom dead center B.
- In FIG. 4, the intake valve is open from A (top dead center) to E at the start of the intake stroke,

and then over trace H, which occurs over about 50 cc of the compression stroke (from about 275 cc to 325 cc of the 50 to 400 cc stroke).

In both cases, note that the second intake valve openings occur during the *first half* of the compression stroke, i.e., they occur prior to the ~225 cc halfway point of the compression stroke.

Looking to independent claim 1, it is apparent that none of these *Wakeman* methods show or suggest that the intake valve should be open at some time during the latter half of the compression stroke and the first half of the power stroke. Similarly, there is no disclosure or suggestion that the intake valve should be opened after the first half of the compression stroke, as in claim 15. Thus, the rejections are in error and should be withdrawn. If the rejections are maintained, kindly indicate for the record *specifically* where *Wakeman* shows or suggests that the intake valve should be opened over the period recited in claims 1 and 15. "The factual determination of anticipation requires the disclosure in a single reference of every element of the claimed invention. . . . It is incumbent upon the examiner to identify wherein each and every facet of the claimed invention is disclosed in the applied reference." *Ex parte Levy*, 17 USPQ2d 1461, 1462 (Bd. Pat. App. & Int. 1990), citing to *Lindemann Maschinenfabrik GmbH v. American Hoist and Derrick*, 730 F.2d 1452, 221 USPQ 481 (Fed. Cir. 1984); see also 37 CFR §1.104(c)(2), MPEP 707.07(d).

**7. Section 9 of the Office Action: Rejection of Claims 1-24 under 35 USC §102 in view of FR 2476741 to Terracol**

Kindly reconsider and withdraw these rejections. Initially, the rejection is improper because it relies on a foreign-language document without providing a translation of the passages being relied upon. See MPEP 706.02, Section II, "RELIANCE UPON ABSTRACTS AND FOREIGN LANGUAGE DOCUMENTS IN SUPPORT OF A REJECTION": "If the document is in a language other than English and the examiner seeks to rely on that document, a translation must be obtained so that the record is clear as to the precise facts the examiner is relying upon in support of the rejection." The rejection cannot be fully and fairly addressed until a translation is provided.

Second, it does not appear that *Terracol* in fact discloses or suggests the claimed matter. First refer to column 2 lines 3-16 of the aforementioned EP 0473258 to *Wakeman*, which summarizes FR 2476741 to *Terracol* (though referring to it only by its application number 8004030) as follows:

French Patent specification no. 8004030 discloses an internal combustion engine in which the inlet valve can be closed early or late, and also an arrangement where the valve opens twice, once between TDC and BDC and again between BDC and TDC prior to the compression phase. The timings of the inlet valve first closure and its second opening are chosen to minimise the flows and pressure drops across the inlet valve during its second opening. It appears that the engine has a fixed timing camshaft based valve system and thus a butterfly. The mode of engine operation described will cause poor combustion at low loads and with dilute mixtures.

Note the statement that the second intake valve opening is “between BDC and TDC prior to the compression phase”, and that “[t]he timings of the inlet valve first closure and its second opening are chosen to minimise the flows and pressure drops across the inlet valve during its second opening” (which would require the second valve opening to be at bottom dead center, or very close to it, or flow and pressure drop will be greater). Further, the undersigned attorney has generated the following *very rough* translation of the cited page 3 lines 14-32 of *Terracol* via use of web-based translator resources.<sup>1</sup>

One can contemplate that the advantages of the two formulas can be combined by a more complex cam scheme, wherein the inlet valve is opened twice over a cycle:

- During a first period between top dead center and a fraction of the stroke prior to bottom dead center;
- Then, briefly, at the beginning of the stroke towards top dead center, between a point located after bottom dead center and the point chosen for halting the intake stroke and beginning the compression stroke.

With this technique, a small insufficiency or a small excess of intake during the first opening will be compensated by a supplementary admission or ejection during the second, without halting gas transit as required for the simple delay method. In this manner, cylinder filling occurs relatively independent of engine speed.

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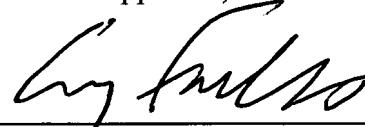
<sup>1</sup> Since machine translation was very rough, the translation is presented here in edited form and accuracy cannot be guaranteed. Some terms did not translate, thereby requiring conjecture as to their meaning.

Thus, it appears that *Terracol*, like *Wakeman*, has a second opening of the intake valve early in the compression stroke, and not during the latter half of the compression stroke as claimed. Kindly withdraw the rejections, or if the rejections are maintained, provide a translation of the passages being relied upon.

**8. In Closing**

If any questions regarding the application arise, please contact the undersigned attorney. Telephone calls related to this application are welcomed and encouraged. The Commissioner is authorized to charge any fees or credit any overpayments relating to this application to deposit account number 18-2055.

For the Applicant,



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**ATTACHMENTS:**

- Replacement Drawing Sheet
- Terminal Disclaimer